Agricultural frontiers in western Brazil

Environmental degradation on the new agricultural frontiers of western Brazil is rapidly worsening. Research is urgently needed there to create stable, rewarding and environmentally sound systems of cultivation and encourage farmers to adopt them.

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For several years, the essential goal of agricultural expansion in Brazil's wet tropical *cerrados* has been to produce the greatest possible surpluses for export. This accelerated development process has led almost invariably to vast monocultures of cash crops such as soybeans. The resulting accelerated degradation of soil fertility, together with changing economic conditions, has meant continual reconsideration of the choice of crops and farming techniques.

Research thrusts

For more than 10 years now producers and researchers have been cooperating closely on a research programme.

Regional agricultural problems are rigorously diagnosed, then new systems of cultivation are tested and compared to traditional systems at a central research station. This station is the main technology showcase and covers between 150 and 250 ha. Large-scale experiments are carried out there on all agronomic and economic factors important to the region.

At the central research station, equipment and staff work under conditions similar to those faced by farmers, to ensure that systems tested will perform as planned. The station works on land development patterns, technical procedures for individual crops, and diversification through the introduction of new plant species or breeding of new varieties.

The central station is backed up by model farms (in Portuguese, *fazendas*) that act as secondary showcases for regional certification and dissemination of the most technically and economically advantageous systems of cultivation and training.

A very important feature of the project is the training it dispenses to those active in development. At the central station and the model *fazendas*, which are permanently open to the public, researchers from various Brazilian and foreign institutions as well as agronomists from the cooperatives, who act as advisers and producers, can study particular subjects or learn more about the technologies on display. They can measure their own performance against these and have access to technological means to improve it, if they so desire.

Main results

Recommendations vary according to soil type, how long the land has been in production, and the

Who is involved

CIRAD has contributed to this project since 1983 by sending several researchers to Brazil. The central project station was moved in order to ensure the greatest possible producer participation. Many different parties are now involved.

At first the project was sponsored by the Centro Nacional de Pesquisa de Arroz e Feijão (CNPAF), a unit of the Empresa Brasileira de Pesquisa Agropecuária, the Brazilian national agronomic research corporation, based in Goiânia in Goias state.

From 1986 to 1992, the central project station was at Fazenda Progresso, a private farm operation located in Lucas do Rio Verde in Mato Grosso state.

Project activities have now been transferred to the Cooperlucas cooperative, also located in Lucas do Rio Verde in Mato Grosso state. This cooperative meets the needs of more than 120 000 ha and, in 1993, marketed more than 180 000 t of grain, the research results are thus being dynamically applied there.

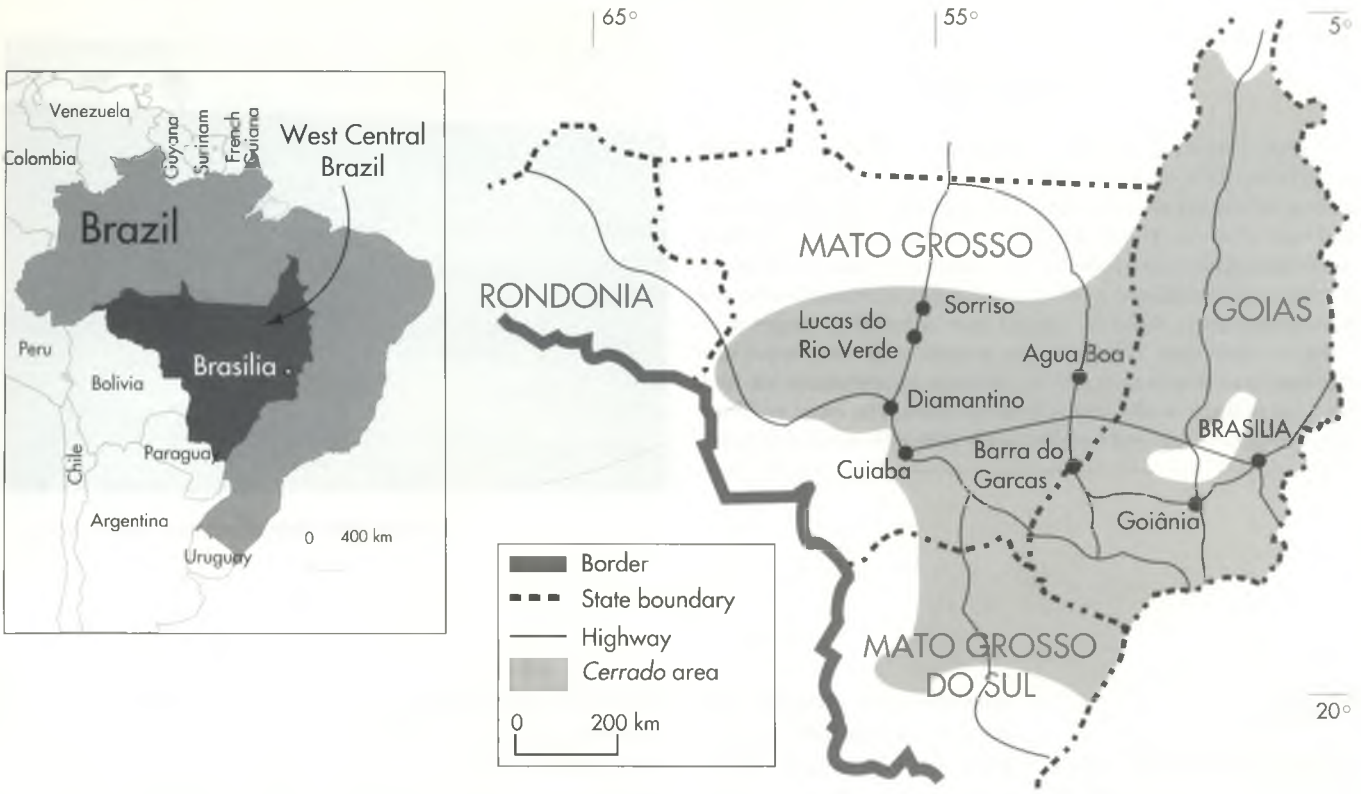

Figure 1. The *cerrados* of West Central Brazil.

producer's resources; some may draw their inspiration from the general pattern of the producer's farming operations.

New cropping

On newly cropped lands or exhausted pastureland, it is recommended that the physical and chemical characteristics of the soil be thoroughly amended, though the extent of this modification naturally varies with the location. The following treatment, for instance, is recommended for many plots during the first year of cultivation: 2 t/ha of thermophosphate, 2 t/ha of dolomitic limestone, 160 kg/ha of potassium chloride, and 600 kg/ha of gypsum.

However, this fertilization must be combined with deep tillage, early sowing and the choice of a very productive variety of rainfed rice. This high rate of enrichment will last three years, with a series of crops that will allow five harvests over that period:

– first year: rice, followed by sorghum or millet;
– second year: soybean, followed by sorghum or millet;
– third year: soybean.

Old croplands

Producers who do not primarily grow soybeans may be advised to use the same crop rotation as for newly cropped lands; for those who do grow soybeans, these may replace the first-year rice crop and be followed by sorghum or millet.

Tillage

In both of the cases described above, deep soil tillage is indispensable for the first planting, while the next four crops are sown directly without tillage.

Proper rotation demands, if rainfed rice is to prosper, that the land be planted with soybeans for at least 2 years beforehand, that sowing be carried out early and that the corrective fertilization with thermophosphates be done. Soybeans require abundant mulching over the two preceding years, early direct sowing and a high level of inorganic fertilization.

Fazenda Progresso. Experimental 1-ha plots of soybeans, maize and rice.
Photo L. Séguy

Cerrados

Cerrados is the name given to a vast tract of land that overlaps the boundaries of the main regional divisions of Brazil (Fig. 1). A large variety of natural environments is found there, including scrub and tree savanna. The cropping systems outlined in this article were developed and applied in agricultural frontier areas in the wet tropical *cerrados* of western-central Brazil (Mato Grosso and Rondônia states). Rainfall, spread over 8 months, ranges from 2 000 to more than 3 000 mm per annum, with very heavy rain that can have devastating effects. Average temperatures are high because of the low elevations in these areas. The most common soils are yellow and red ferralitic soils with little natural fertility.

Terrace cultivation of rainfed rice on fallows.
Photo L. Séguy

Yields

In both situations, yields obtained in real growing conditions at the central station and the model *fazendas* are close to 4 t/ha for soybeans and 5 t/ha for rainfed rice.

As for millet and sorghum, with minimal input they reach production levels of 1.2 to 3 t/ha.

Concerning cost-effectiveness, the most stable systems, over 3 years, can generate very attractive net per-hectare profits (around $85-200 US) despite generally poor economic conditions.

Varieties

In this region, the rainfed rice crop, like soybeans, has become a major economic speculation. Rice breeding efforts have focused on improving its productivity and quality. Several cultivars (and CIAT 20 in particular) have been singled out for use in these very productive cropping systems, as they yield between 2.5 and 3.2 t/ha where fertility is low and more than 5 t/ha where it is high. Other varieties are constantly being introduced and tested to see how they stand up under changing conditions, such as the appearance of a new pest or disease or price fluctuations.

The use of growth regulators on soybeans is another of the techniques being tested to increase production and improve harvest conditions.

New concepts

Because of exposure to very adverse climatic conditions, the project has had to develop cropping systems and technologies suited to this environment. The goal is to make the best use of natural resources while fully protecting the soil from the phenomenal erosion often encountered in these areas.

The systems used are based on no-tillage direct sowing. In this way, crops can be grown on a permanent plant cover made up of a growing crop or stubble from various crops. When proper annual rotations are carried out, the plant cover can be maintained, inorganic elements leached into the soil can be recycled, and weeds can be controlled (herbicides, shade effect, allelopathy).

Rotations involving two crops a year — rice followed by sorghum or millet and soybean followed by sorghum or millet — are two very common techniques that utilize direct sowing with a mulch of crushed plant stalks. Soybeans, when grown along with the cover crop *Paspalum notatum*, afford an annual pulse crop followed by a pasture crop. These different systems may be practised in rotation with pastures sown

Brazilian zebu grazing and husbandry.
Photo CIRAD-EMVT

with *Brachiaria brizantha* and *Panicum maximum*, thus fostering the integration of animal husbandry and agriculture.

International impact

Farmers then enjoy agronomically better-performing systems and economically more stable ones. These techniques developed in the Mato Grosso can, with suitable adaptations, be applied to a number of wet tropical and low-lying equatorial areas. Moreover, part of the know-how acquired in Brazil, with respect to techniques and research methods, is already in use in other parts of the world: exchanges are increasingly taking place with researchers in other parts of Brazil, in Côte d'Ivoire, Gabon and Vietnam, to name just a few. These exchanges mainly have to do with the methods used by researchers to train and encourage farmers to apply these stable and lucrative cropping systems on their own lands.

References

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Abstract... Resumen... Résumé

L. SEGUY, S. BOUZINAC – **Agricultural frontiers in western Brazil.**

Innovations are being introduced in pioneering agricultural regions in western Brazil. Experiments have been carried out under on-farm conditions in an attempt to match the techniques proposed to the environment. Model farms are open to the public at all times, enabling agricultural research and development to benefit from the results. Landscape planning, crop rotation, direct seeding and cropping on plant cover are just a few examples of techniques already applied on a large scale in the wet tropical regions of Brazil. Among other benefits, they make it possible to halt the phenomenal erosion prevalent in these zones while giving farmers attractive yields and net per-hectare financial profits.

Key words: soya, rainfed rice, grazing, farming system, direct seeding, tillage, fertilisation, erosion, Brazil.

L. SEGUY, S. BOUZINAC – **Fronteras agrícolas del Oeste de Brasil.**

Los frentes pioneros agrícolas del Oeste de Brasil son el lugar de innovaciones en lo referente a sistemas de producción estables. Los experimentos se realizan en condiciones de explotación agrícola, garantizando así una perfecta adecuación entre las técnicas propuestas y el medio. La apertura permanente al público de las explotaciones de referencia permite que el desarrollo y la investigación agrícolas se aprovechen estos resultados. Ordenación del paisaje, sucesiones culturales, siembra directa sin trabajo del suelo y cultivo sobre cobertura vegetal son algunos ejemplos que ya se aplican a gran escala en las regiones tropicales húmedas de Brasil y que permiten, entre otras cosas, yugular la erosión fenomenal que cunde en esas zonas, ofreciendo al mismo tiempo a los agricultores unos rendimientos y un margen financiero neto por hectárea atractivos.

Palabras clave : soja, arroz pluvial, pasto, sistema de producción, siembra directa, trabajo del suelo, fertilización, erosión, Brasil.

L. SEGUY, S. BOUZINAC – **Frontières agricoles de l'Ouest du Brésil.**

Les fronts pionniers agricoles de l'Ouest du Brésil sont le lieu d'innovations en matière de systèmes de production stables. Les expérimentations sont conduites dans les conditions des exploitations agricoles. Elles garantissent ainsi une parfaite adéquation entre les techniques proposées et le milieu. L'ouverture permanente au public des exploitations de référence permet au développement et à la recherche agricoles de bénéficier de ces résultats. Aménagement du paysage, successions culturales, semis direct sans travail du sol, culture sur couverture végétale, sont quelques exemples déjà appliqués à grande échelle dans les régions tropicales humides du Brésil. Ils permettent, entre autres, de juguler une érosion phénoménale qui sévit dans ces zones, tout en procurant aux agriculteurs des rendements et une marge financière nette à l'hectare attractifs.

Mots-clés : soja, riz pluvial, pâturage, système de production, semis direct, travail du sol, fertilisation, érosion, Brésil.